U.S. DEPARTMENT OF ENERGY

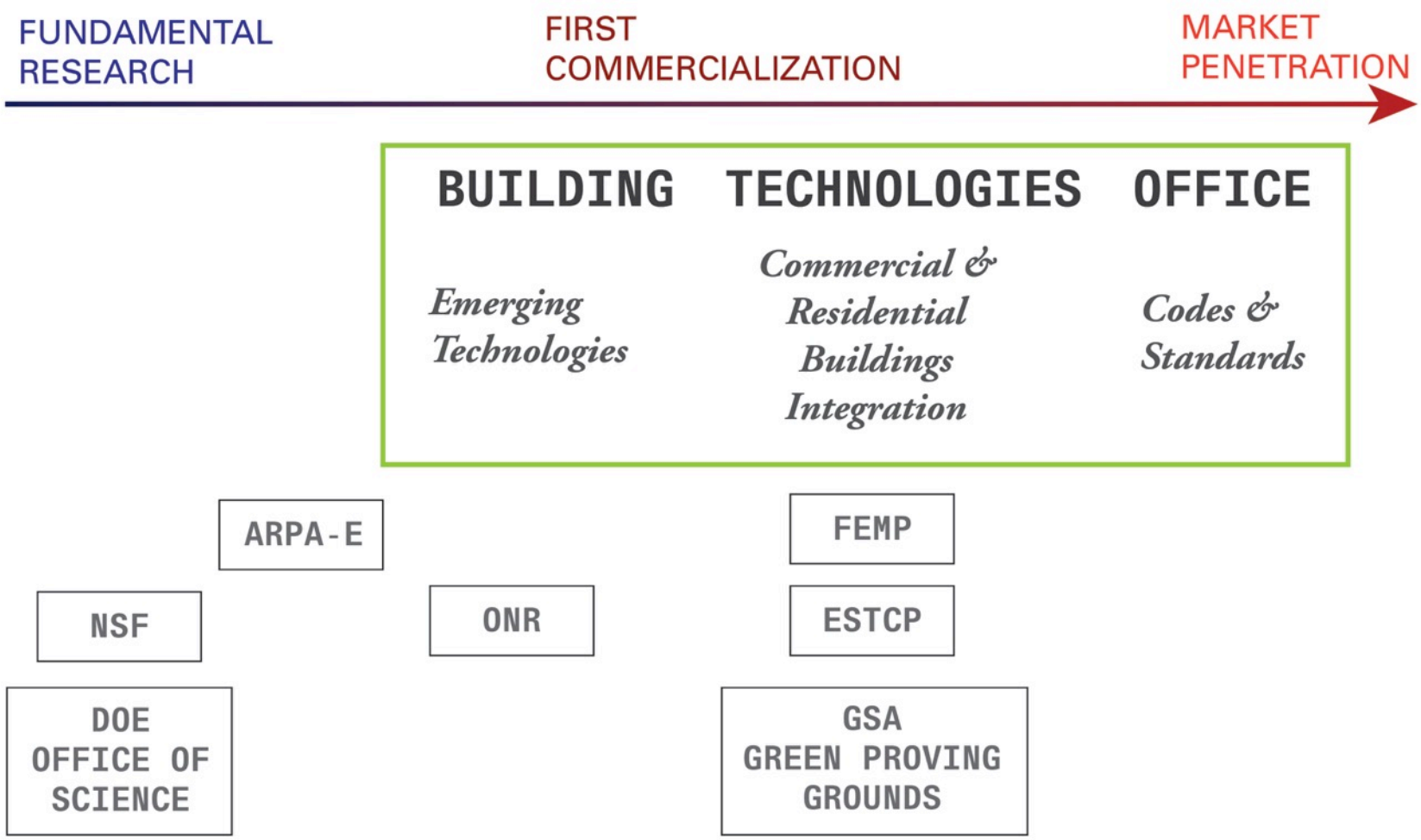
BUILDING TECHNOLOGIES OFFICE

An Overview & Areas of Interest

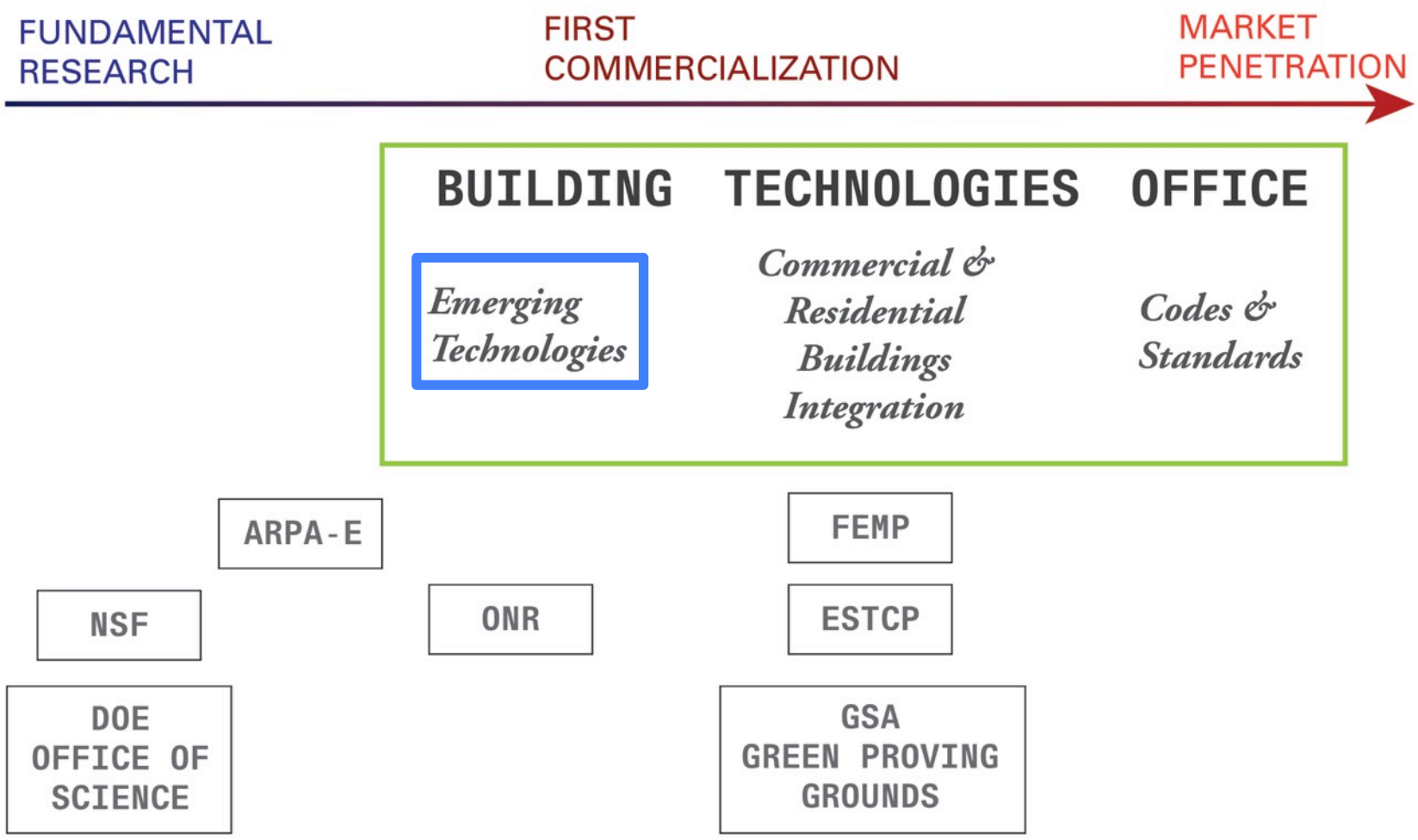
Jared Langevin
EERE Science & Technology Policy Fellow

ARPA-E DELTA Kickoff
Portland, OR, May 21-22, 2015

Building Technologies Office on the R&D Spectrum

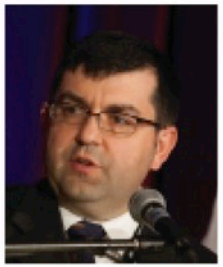
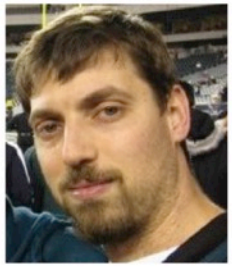


Building Technologies Office on the R&D Spectrum



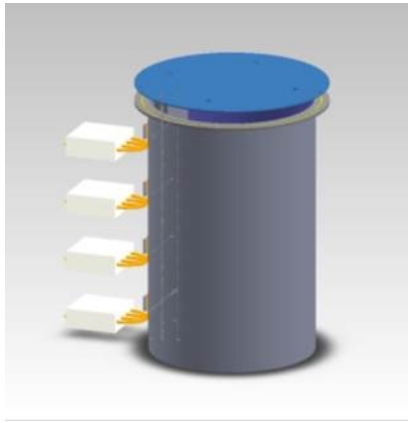
Emerging Technologies R&D Areas & Goals

	Solid State Lighting	HVAC / Water Heating / Appliances	Windows & Envelope	Building Energy Modeling	Sensors & Controls
2020 Primary Energy Reduction Goal	*30%*	*10% (HVAC)* *20% (WH)* *15% (Appl.)*	*15%*	*TBD*	*10%*
2030 Primary Energy Reduction Goal	*65%*	*25% (HVAC)* *35% (WH)* *30% (Appl.)*	*35%*	*TBD*	*20%*

Technology Manager					
					
	Jim Brodrick	Tony Bouza	Bahman Habibzadeh	Amir Roth	Marina Sofos

HVAC, Water Heating, & Appliances R&D

- **Near-term and next-gen tech. acceleration:**
  - Adv. and Non-Vapor Compression (VC) heat pumps
  - Low Global Warming Potential (GWP) refrigerants
  - Regional and integrated solutions
  - Simplest application first (i.e., non-VC water heating)



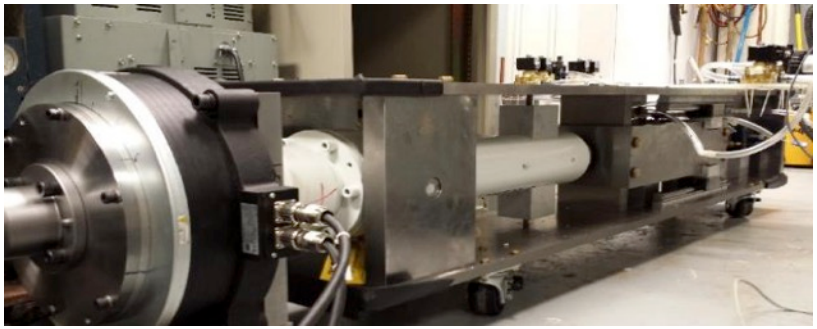
Sheetak thermo-electric water heater.

- **Technical roadmap documents:**
  - HVAC: http://energy.gov/eere/buildings/downloads/research-development-roadmap-emerging-hvac-technologies
  - Water Heating: http://energy.gov/eere/buildings/downloads/research-development-roadmap-emerging-water-heating-technologies
  - Low GWP Refrigerants: http://energy.gov/eere/buildings/downloads/research-development-roadmap-next-generation-low-global-warming-potential
  - Next-Gen Appliances http://energy.gov/eere/buildings/downloads/research-development-roadmap-next-generation-appliances

HVAC R&D Examples

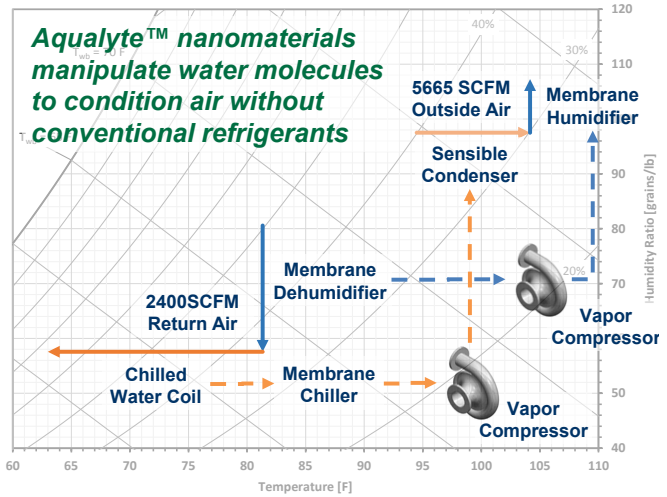
Non-VC, Low GWP Cooling Systems

- **MD Energy & Sensor (MEST):**
  - Thermoelastic cooling
  - High power density refrigerant bar loading belt
  - Addresses size/weight and material cost barriers to system



MEST GEN-III prototype.

- **DAIS Analytic**
  - Membrane HVAC and electrochemical vapor compressor
  - Targeting commercial RTUs, Dedicated Outdoor Air Systems
  - ORNL testing and modeling



Windows & Envelope R&D

- **Highly insulating windows and building envelope**
  - Windows: R-10 (residential); R-7 (commercial)
  - Opaque Envelope: R-12/in. retrofit
  - Infiltration: <1 ACH50 (residential); <0.25 CFM75/ft^2 (commercial)
- **Dynamic windows**
  - Windows and window films
  - Δ SHGC > 0.4

Key barrier: cost-effectiveness
(3X cost multiplier from components to install)

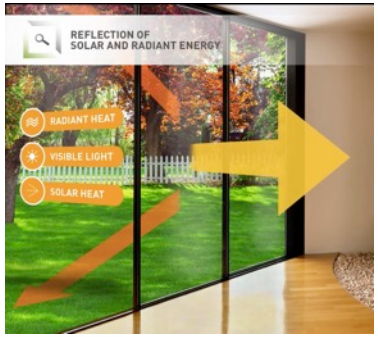
- **Daylighting**
  - 50% lighting energy reduction for 50 ft. floor plate
- **Technical roadmap documents:**

http://energy.gov/sites/prod/files/2014/02/f8/BTO_windows_and_envelope_report_3.pdf

Windows R&D Example

Window Attachments

- **Benefits:**
  - Cost effective retrofit application
  - Add energy saving potential



EnerLogic®

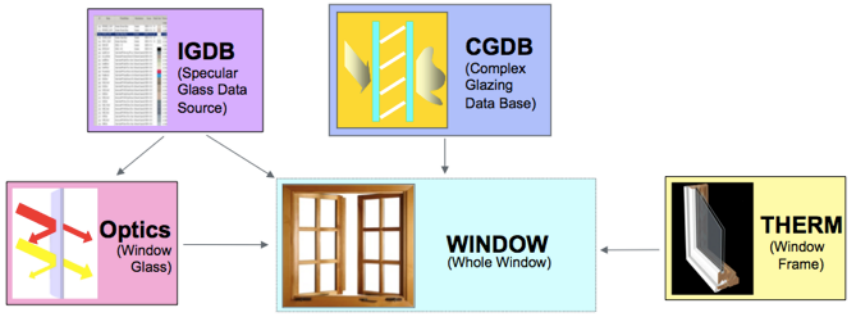
- **EnerLogic window film:**
  - Deposited low-emissivity gold material coating
  - Up to 50% cooling and 10% heating cost savings
  - Invisible appearance
  - ~ 1/3 cost of replacement windows

Windows R&D Example
CRAFT & Attachments Ratings

- **CRAFT Funding Opportunity** (2014, 4 yrs.)
  - Develop/oversee energy performance-based rating/certifications for window attachments
  - Develop attachment performance database
  - Attachments Energy Ratings Council (AERC)

WCMA
Window Covering Manufacturers Association

- **Considerations for Emerging Attachments:**
  - Selling energy savings & comfort – label matters!
  - Early involvement in ratings programs is good
    - Modeling tools must work with your product
  - LBNL is a great resource



Building Simulation R&D

EnergyPlus & OpenStudio

- **EnergyPlus**
  - Whole building energy modeling engine
  - Supports multiple use cases
  - Recently redeveloped in C++ for speed/interoperability

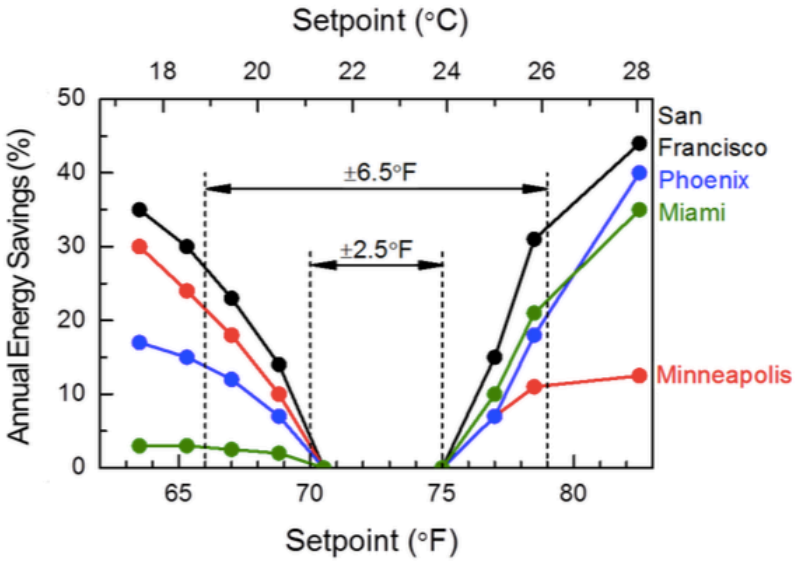


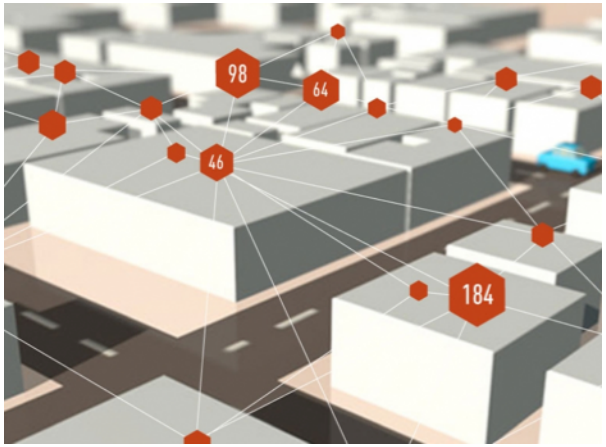
Image source: Hoyt et al, 2009

- **OpenStudio**
  - "Operating system" for building energy modeling
  - Supports creation of "measures"
    - Building Component Library

github.com/NREL/EnergyPlus
github.com/NREL/OpenStudio

Sensors & Controls R&D

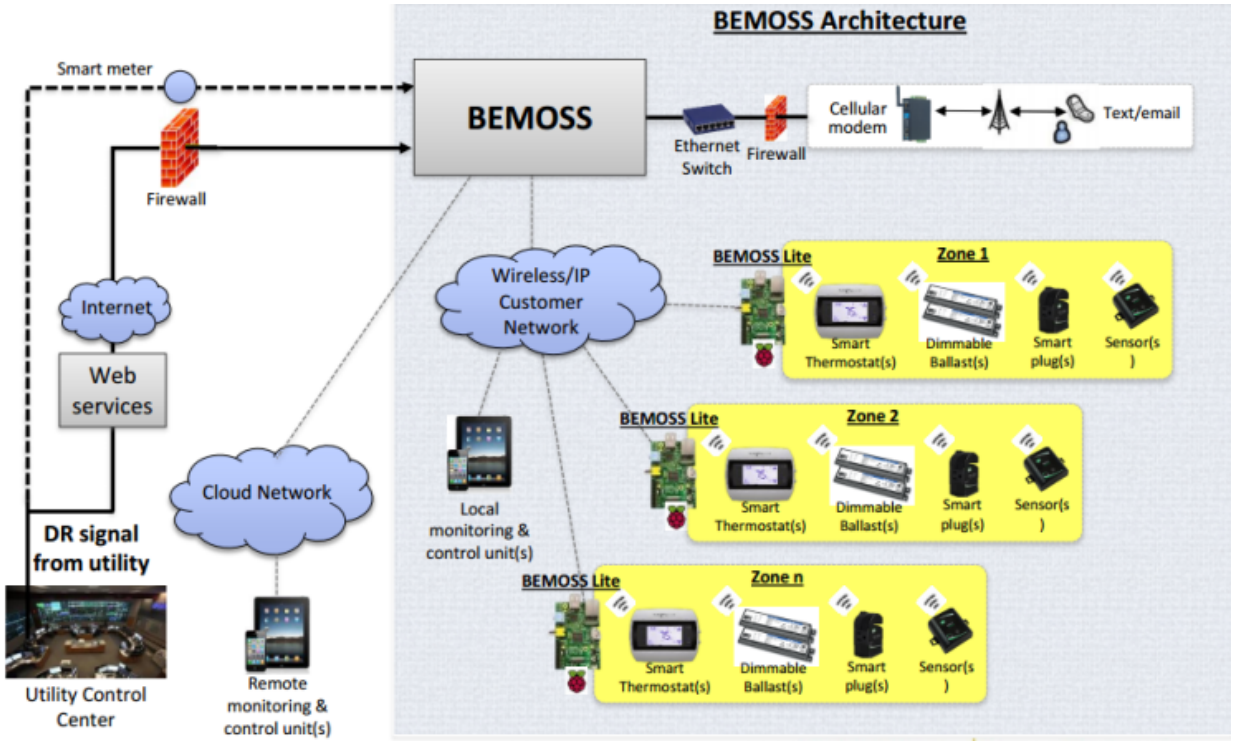
- **Vision:** self-configuring, self-commissioning, self-learning buildings that participate in transactions
- **Open-source sensors**
  - Wireless, self-powered sensor packages
- **Foundational control theories**
  - Control algorithms and applications
- **Transaction-based controls**
  - Open-architecture control platforms
  - Transaction-ready buildings
- **Roadmap forthcoming** (workshop @ 2015 BTO Peer Review)



S&C Transactional Network.

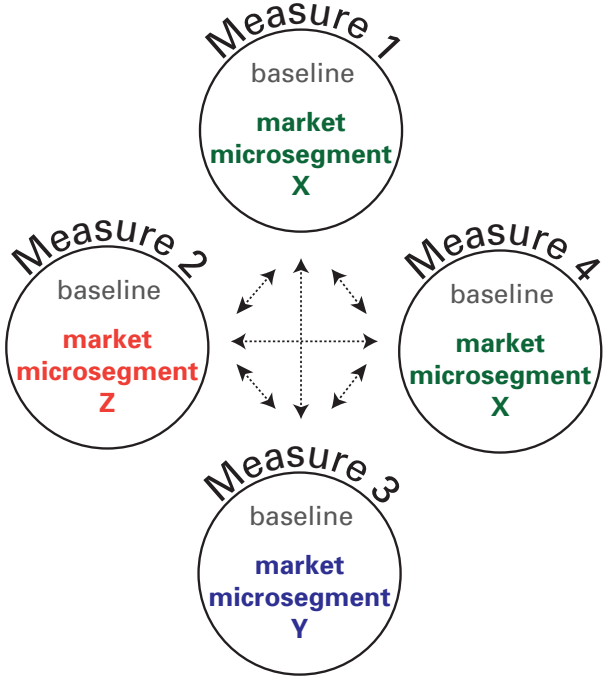
Sensors & Controls R&D Example

Building Energy Management Software

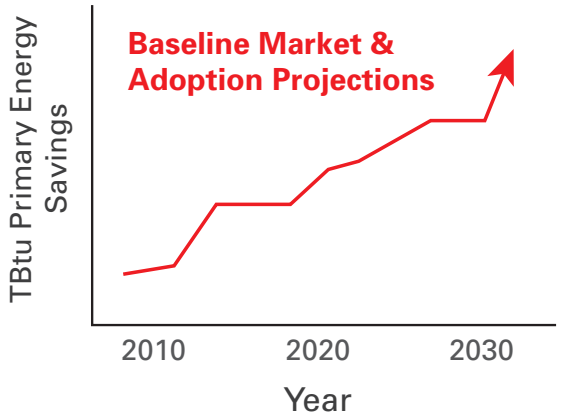


- Open architecture control system for small/medium buildings
- Optimize energy efficiency and occupant comfort

Building Efficiency R&D Prioritization



MEASURES & MARKETS
(EIA AEO)



PROJECTION HORIZON
(EIA AEO)

Primary Energy

Carbon Emissions

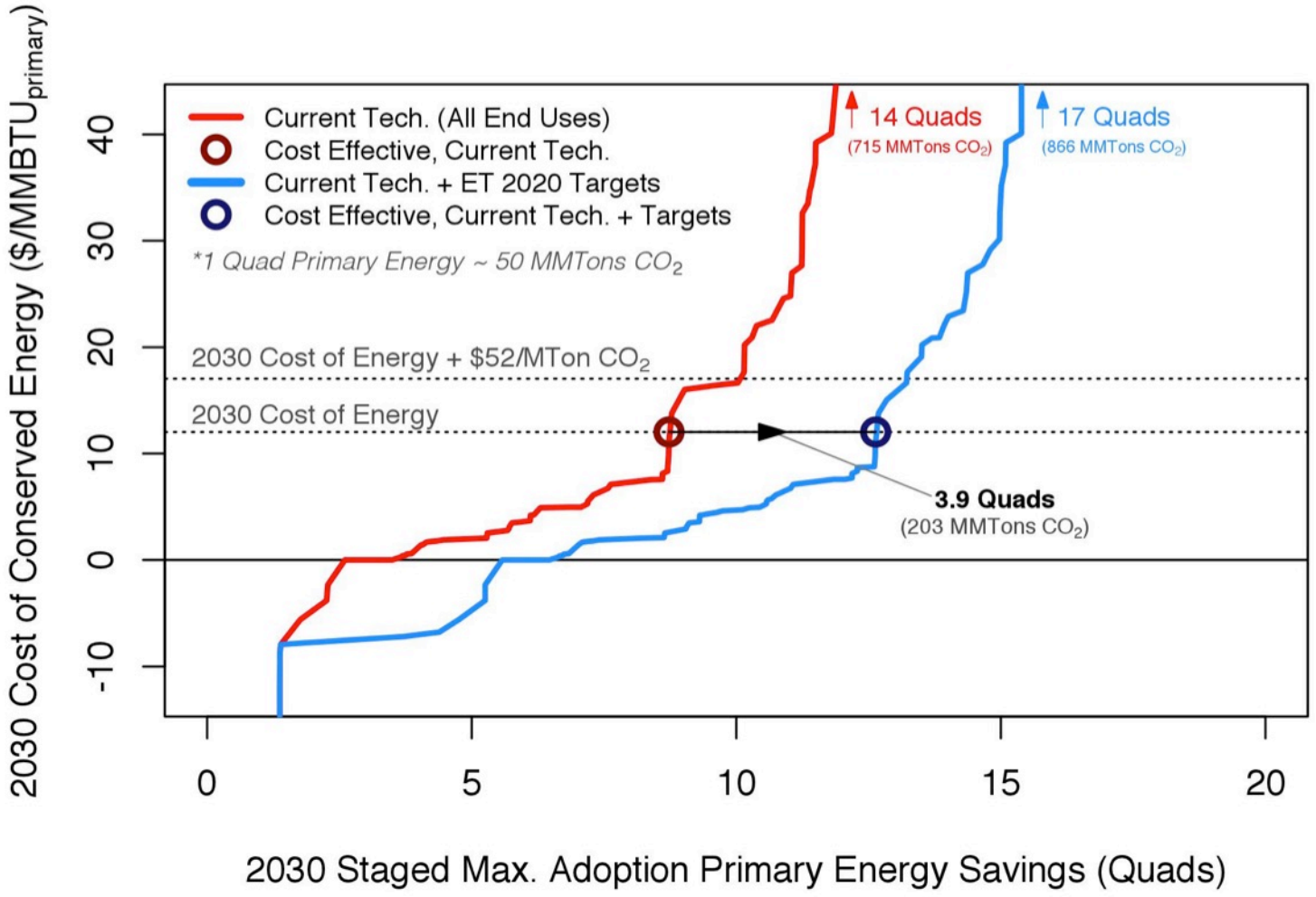
Other (?)

Non-Energy Benefits (NEBs)

POTENTIAL IMPACTS
(measure-by-measure & aggregated)

Impact Snapshot

Sector-Wide Savings & Costs, 2030



How to Get Involved with BTO

- **Apply to Funding Opportunity Announcement (FOA):**
  - 2016 BENEFIT and BUILD, Solid State Lighting FOA
- **Participate in a roadmapping workshop:**
  - Building Energy Modeling Workshop
    Seattle (June 9th) & DC (June 15th)
- **Volunteer to be a reviewer**
- **Participate in Requests for Information (RFIs) and annual program peer review**
- **Buildings of the Future Scoping Study** (futurebuildings.pnnl.gov)
- **Subscribe to BTO updates** (energy.gov/eere/buildings)





THANK YOU

jared.langevin@ee.doe.gov